IN THE CLAIMS

1. (Original) An optical encoder sensor head for use with a reflective multi-track encoder scale, comprising:

a quasi-monochromatic light source disposed on a surface of a planar substrate facing the encoder scale;

a plurality of optical detectors disposed on the surface of the substrate at respective locations defining respective optical paths between the optical detectors and respective tracks of the encoder scale; and

an optical wavefront dividing element disposed between the substrate and the encoder scale, the optical wavefront dividing element being operative to divide an incident light beam produced by the light source into a plurality of diffracted light beams, each diffracted light beam being directed toward a respective track of the encoder scale at a respective angle so as to be reflected from the respective track along the optical path to the respective detector.

2. (Original) An optical encoder sensor head according to claim 1, wherein the quasi-monochromatic light source comprises a vertical cavity surface emitting laser (VCSEL).

3. (Original) An optical encoder sensor head according to claim 1, wherein the quasi-monochromatic light source emits an expanding cone of light.

4. (Original) An optical encoder sensor head according to claim 1, wherein the plurality of optical detectors includes two optical detectors disposed on opposite sides of the light source.

5. (Original) An optical encoder sensor head according to claim 1, wherein the substrate is a first substrate, and wherein the wavefront dividing element comprises a diffractive optical element (DOE) disposed on a second substrate.

6. (Original) An optical encoder sensor head according to claim 5, wherein the DOE comprises a layer of material having a thickness selected to introduce a substantially half-wave delay in light passing through the DOE.

7. (Original) An optical encoder sensor head according to claim 5, wherein the DOE comprises a grating having a square wave profile.

8. (Original) An optical encoder sensor head according to claim 5, wherein the DOE comprises a grating having a triangle wave profile.

9. (Original) An optical encoder sensor head according to claim 5, wherein the DOE comprises a grating having a-sine wave profile.

10. (Original) An optical encoder sensor head according to claim 5, wherein the second substrate further includes a plurality of windows, each window lying along a corresponding one of the optical paths between the tracks on the encoder scale and the detectors.

11. (Original) An optical encoder sensor head according to claim 5, wherein the second substrate comprises a substantially optically transparent material having a low coefficient of thermal expansion.

12. (Original) An optical encoder sensor head according to claim 5, wherein the second substrate is coated with optically transparent material having an index of refraction n different from that of air.

13. (Original) An optical encoder sensor head according to claim 12, wherein the optically transparent material comprises a dielectric material.

14. (Original) An optical encoder sensor head according to claim 13, wherein the dielectric material has a refractive index close to the refractive index of the second substrate.

15. (Original) An optical encoder including:

a sensor head including a substrate and beam divider, the beam divider including an optical wavefront dividing element, the substrate having a light source and first and second optical detectors disposed thereon;

an encoder scale including first and second tracks, the encoder scale being disposed opposite the sensor head with the beam divider disposed therebetween such that a light beam emitted by the light source is incident on the wavefront dividing element, the wavefront dividing element being operative to divide the incident beam into first and second beams being substantially incident on the first and second tracks of the encoder scale respectively, light from the first beam being reflected and diffracted by the first track to the first optical detector, and light from the second beam being reflected and diffracted by the second track to the second optical detector; and

a signal processor operative to interpret signals from the first and second detectors.

16. (Original) An optical encoder including:

a sensor head including a substrate having a light source and first and second optical detectors disposed thereon;

an encoder scale including first and second tracks; and

a wavefront dividing element disposed between the sensor head and the encoder scale, the wavefront dividing element being operative to divide an incident light beam emitted by the light source into first and second beams, the first beam being incident on the first track of the encoder scale, the second beam being incident on the second track of the encoder scale, light from the first beam being reflected and diffracted by the first track to the first optical detector, light

from the second beam being reflected and diffracted by the second track to the second optical detector.

17. (Original) An encoder according to claim 16, wherein the wavefront dividing element is disposed on a substrate of the beam divider disposed between sensor head and the encoder scale.

18. (Original) An encoder according to claim 17, wherein the substrate of the beam divider is fixed relative to the substrate of the sensor head.

19. (Original) An encoder according to claim 17, wherein the substrate of the beam divider and the substrate of the sensor head are fixed into a single monolithic construction.

20. (Original) A sensor head for use in an optical encoder, the encoder including a scale, the scale being movable relative to the sensor head along a first axis, a distance between the scale and the sensor head as measured in a direction substantially perpendicular to the first axis being substantially constant, the encoder generating a signal representative of a position of the scale relative to the sensor head, the scale including a first track and a second track, the sensor head comprising a substrate, a light source, a first optical detector, a second optical detector, and a beam divider including an optical wavefront dividing element, the light source being disposed on the substrate, the first and second optical detectors being disposed on the substrate, the beam divider being spaced apart from and fixed relative to the substrate, an emitted light beam emitted from the light source being incident on the wavefront dividing element, the wavefront dividing element dividing the emitted light beam into a first light beam and a second light beam, the first light beam being incident on the first track, the second light beam being incident on the second track, light diffracted from the

first track being incident on the first optical detector, light diffracted from the second track being incident on the second optical detector.

21. (New) An optical encoder sensor head according to claim 1, wherein the tracks of the encoder scale include (1) a first track having a diffractive optical element for forming a line image indicative of an index location of the scale, and (2) a second track having a diffraction grating for forming a diffraction pattern indicative of incremental position of the scale.

22. (New) An optical encoder sensor head according to claim 1, wherein the number of optical detectors is two, and wherein the wavefront dividing element has a periodic grating pattern with a period P satisfying the following relationship:

$$\tan\left(\lambda/_{P}\right)=\frac{Y+d}{2(2D-Z)}$$

where λ is the wavelength of the light source, Y is a height of a largest one of the optical detectors, d is a separation between the optical detectors, D is a separation between the planar substrate and the encoder scale, and Z is a separation between the planar substrate and the wavefront dividing element.